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Real-time Routes Design Research of DIY tour Based on Greedy Algorithm

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ABSTRACT

Compared with group tour, DIY tour is characterized by flexible time arrangements and uncertain routes planning. This paper has mainly employed partial greedy algorithm based on time series in designing real-time routes in DIY tours. As restaurant and accommodation are featured by time window constraint, thus the design is divided into several time partitions in line with 24-hour clock, and each partition has its tour behaviors including sighting, restaurant and accommodation. In each partition and its joint, the paper has availed partial optimal strategy of greedy algorithm so as to complete the overall routes design.

Keywords: DIY tour routes design, real-time, greedy algorithm, partial optimum strategy.

INTRODUCTION

Recently, DIY companion tour has increasingly become the prevailing trend of people's travel mode. However, as the present DIY tour is still at its start-up stage, there are problems such as information asymmetry, inexperienced tourists, and high time cost and so on. Therefore, a tour routes designing system that combines operation modes of traditional travel agencies and DIY tour's advantage of flexibility is in urgent need, so that we can respond to emergencies timely and design optimal routes for DIY tourists. This paper has drawn several time- and multipoint-orientated problems, made choice and combination based on greedy algorithm, and obtained customers' optimal tour routes.

REAL-TIME ROUTES DESIGN FOR DIY TOUR

Determine types of time partitions

Time constitutes the most important limited factor in designing DIY tour routes. To take into account of tourists' food, accommodation and sightseeing, maximum benefit should be achieved in limited time with the premise of meeting all inhomogeneous demands. To ensure real-time performance of tour routes design, tourists' remaining time must be timely counted, so that the corresponding tour activities can be arranged. Therefore, This paper has drawn the chart 1 for time partition of DIY tour and determined specific partition types according to tourists' tour periods.

If the tour period starts from 9 am. to 6 pm., then the corresponding time partition type is S_1-R_1-S_2-R_2 .If from 1 pm. to 10 pm., then S_2-R_2-S_3-A. If from 8 am. to 3 pm., then S_1-R_1-S_2 .And so the rest.

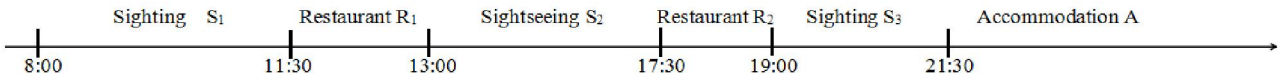

Chart 1:Time partition chart for DIY tour

Referent indexes in designing DIY tour routes

The design of DIY tour routes is a personalized recommendation based on tourists' status.This paper has drawn several time- and multipoint-orientated problems and guided the design by partial optimum principle of greedy algorithm. In the design, The paper has included rigid and flexible indexes as referent indexes. Rigid index is also named determined index, which plays an irreplaceable part in routes design, such as sightseeing period, start place, transportation, destinations (scenic spots, hotels and restaurants). Flexible index is also subsidiary index, which includes tour types, number of tourists, tour budget,

preferable scenic spots, restaurants and accommodations, etc. it provides data sources for DIY tour design.

Table1: Referent indexes in designing DIY tour routes

Type of Indexes	Indexes	Functions
Rigid Indexes	Period	to determine types of time partition
	Start place	to determine the start and ending sites
	Transportation	to obtain time and distance and profit values
	Targeted sites	to determine optimal sites of routes design
Flexible Indexes	Tour Types	Recommended sites for food, shelter, sightseeing and shopping
	Budgets	one of important limitations for tourists' travel plan
	Preferable sites	to re-filter certain sites in making choices
	Number of tourists	the optimal choice for scenic spots, restaurants and hotels
	……	

Routes design guided by greedy algorithm

Compared with traditional travel agencies, DIY tour is characterized by flexible time arrangements and uncertain routes planning. The survey analysis has it that DIY tourists pay more attention to satisfaction than completion in the process of sightseeing, which creates the possibility of temporary changes in DIY tour. As for tourists, the biggest problem is to make the optimal choice in case of temporary changes, rather than how to plan the following routes.

Therefore, the paper is targeted at solving problems in line with tourists' psychological demands in the real process of travel. The greedy principle is aimed at dividing the whole process into several procedures, getting access to the target from one initial solution and making partial optimal choices rather than whole- targeted.

DESIGN PROCEDURE FOR GREEDY ALGORITHM

In line with the flexible indexes of routes design, the paper has chosen several assemblies of demand points, obtained the maximum partial profit and get the final complete route according to time partition.

Firstly, according to user's flexible indexes, I have selected several demand points from the database and constituted an assembly S/R/A that complies with user's demand.

Secondly, in accordance with the with the start point and time, every partition should have a corresponing demand point assembly.

Thirdly, when a user has input a pinpoint, figure out if the pinpoint has the maximal yield point, if so, the pinpoint is the partial maximum solution; and if not, the demand point will be the partial maximum solution.

Fourthly, take accord with the ending time of every demand point and set it as the start time of next demand point, repeat the third procedure until time is completely distributed.

Finally, I have designed a tour route that meets users' demands and preferences, and the route is partially optimized. Detailed procedure is showed in chart 2.

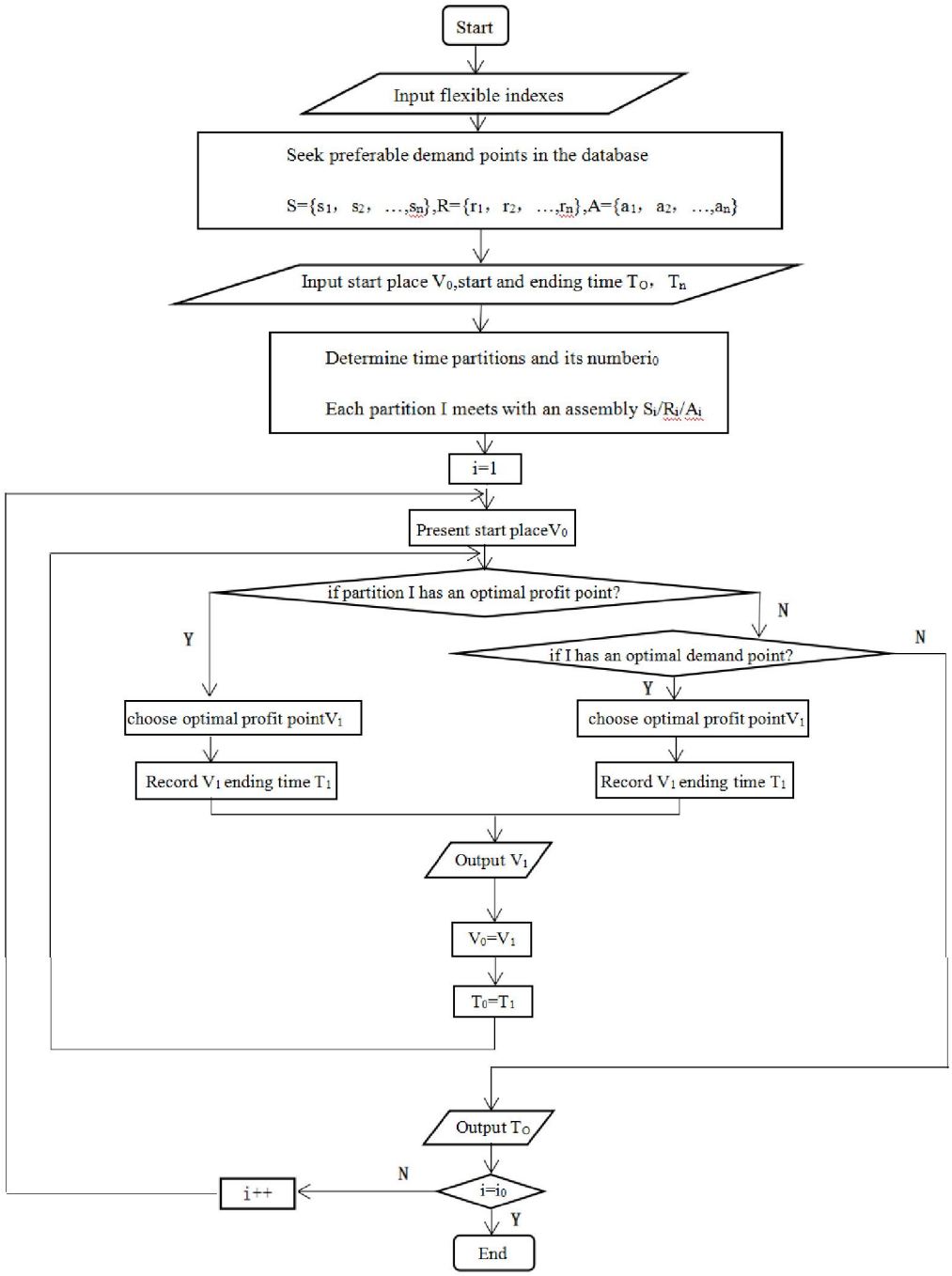

Chart 2:Algorithm procedure of DIY tour routes design

EXAMPLES OF VERIFICATION

This paper has employed simulated case in analyzing the implication of greedy algorithm in tour routes design.

Assuming that a tourist's tour demand is: tour period starts from 8 am. to 1 pm.(time partition S_1-R_1), start place is V_0,targeted scenic spot is s_4.According to the flexible indexes, the paper has obtained a assembly of scenic spots and restaurant, $S=\{s_1,s_2,s_3,s_4,s_5,s_6\}$, $R=\{r_1,r_2,r_3\}$. The time intervals for each demand points are as table 2, recommend level and service time are positively correlated as table 3. The latency time among demand points are omitted.

Table2:Start and end place and time intervals for each demand points (unit: hour)

	V_0	s_1	s_2	s_3	s_4	s_5	s_6	r_1	r_2	r_3
V_0	0	0.5	0.6	0.2	0.6	1.0	0.8	0.3	0.9	1.5
s_1	0.5	0	0.8	1.0	1.2	1.2	2.0	0.2	1.8	2.5
s_2	0.6	0.8	0	0.5	1.8	1.6	1.0	0.2	1.0	3.0
s_3	0.2	1.0	0.5	0	0.5	0.8	0.3	0.3	0.5	1.2
s_4	0.6	1.2	1.8	0.5	0	0.2	0.7	0.6	0.3	0.4
s_5	1.0	1.2	1.6	0.8	0.2	0	2.0	1.4	0.5	0.3
s_6	0.8	2.0	1.0	0.3	0.7	2.0	0	1.2	0.4	2.0
r_1	0.3	0.2	0.2	0.3	0.6	1.4	1.2	0	1.4	2.2
r_2	0.9	1.8	1.0	0.5	0.3	0.5	0.4	1.4	0	0.5
r_3	1.5	2.5	3.0	1.2	0.4	0.3	2.0	2.2	0.5	0

Table3:Recommend level and service time for each demand point (unit: hour)

Demand point	Recommend level	Service time
s_1	8.5	0.8
s_2	7.0	1.0
s_3	8.6	0.8
s_4	8.0	1.0
s_5	6.5	0.5
s_6	9.3	1.0
r_1	8.5	1.0
r_2	7.8	0.8
r_3	9.5	1.2

In line with the partial optimal principle in tour routes design, this tourist starts from V_0, determines the first scenic spot s_4 and finish sightseeing at 9:36 am., with 1.9 hour surplus time. In terms of time limitation, (sightseeing time + service time <= surplus time). The alternate scenic spots include s_3, s_5 and s_6, obtain their per unit time profits and choose the maximum one as s_4. As per unit time profit is satisfaction / (sightseeing time + service time), thus s_6 gets the optimal per unit time profit. The corresponding time is 10:48 and surplus time is 0.7 hours. As there is no follow-up scenic spot meets the time limitation, thus it transits to next time partition. Dinning hour remains 2.2 hours, alternate demand point are r_1、r_2, likewise, the per unit optimal time profit of r_1 and r_2 are 3.86 and 6.5, thus r_2 is the ideal restaurant. As a whole, the overall tour route is completely designed and the targeted design is perfectly completed within every time partition.

CONCLUSION

The research on real-time DIY tour routes is based on the greedy algorithm and is aimed at partial optimum all along the whole process. Its top advantage is easy to complete, it need not backtrack and thus avoids deadlocks. It is only based on the present situation and thus conforms to the balance of speed and profit and gives full play to its advantage. The time partition principle based on sequence effectively solves the problems of diversified demands in DIY tour, so that achieves the optimal partial profit.

However, we should not lose sight of the following disadvantages. Firstly, with regard to fixed point assemblies, the paper has simply used principle of prioritizing fixed point and neglected how to ensure maximum profit for per unit time. Secondly, in the last time partition, the paper fails to omit time cost in choosing optimal demand point and thus results in time surplus.

As a whole, the DIY tour routes design and its core algorithm are still feasible and ready to refer, because it will provide with new thoughts and methods for DIY tourists in promoting DIY tour.

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